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# BASIC CARE AND MAINTENANCE OF OPHTHALMIC EQUIPMENT

**Health Care Technology Unit**
**ORBIS Flying Eye Hospital**

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# Food for thought…

# (Core) Truth

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"Technology plays a key role in health care."

# (Painful) Truths

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- “When it comes to technology, it’s not a matter of IF it’s going to fail, but WHEN…”

# (Most painful) truth

- Maintenance of medical technology will only be effective if backed up by consistent policies on planning and management.

# OPHTHALMIC EQUIPMENT NEED TO BE TREATED LIKE BABIES…

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Photo:

Peruvian girl from the floating islands of *Los Uros, Titikaka* Lake. April 2006

# LOVE YOUR EQUIPMENT…

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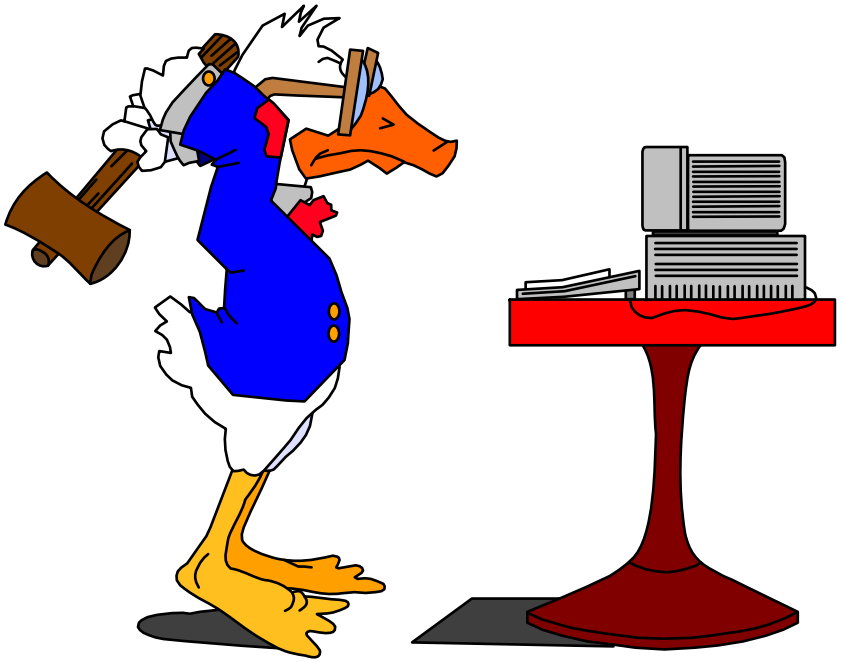

# YOU DON'T HAVE TO BE A VICTIM OF YOUR EQUIPMENT

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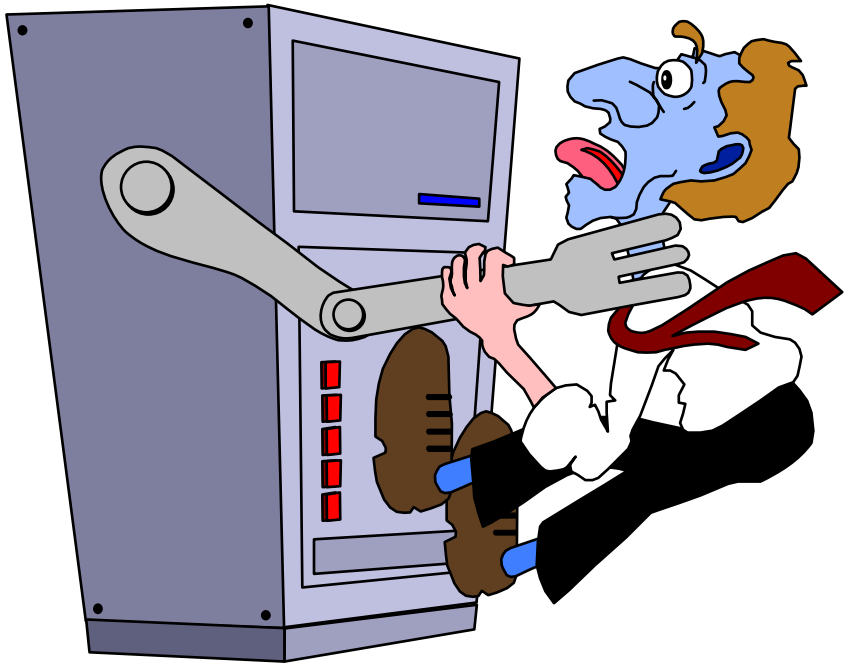

# AVOID DEPENDENCY

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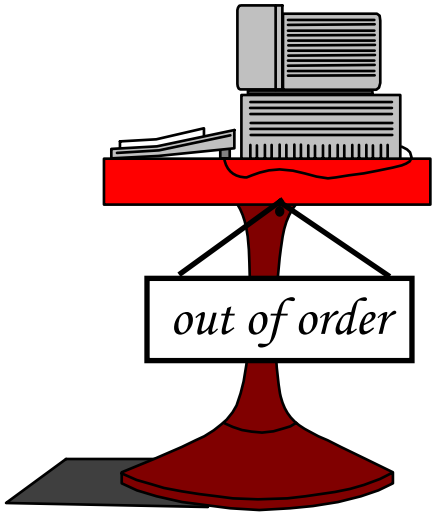
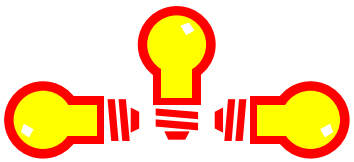
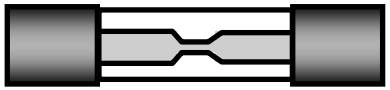


- As a result, equipment downtime can be reduced.

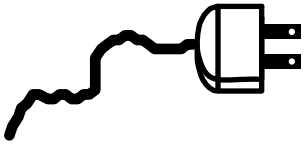
# GENERAL EQUIPMENT CONSIDERATIONS



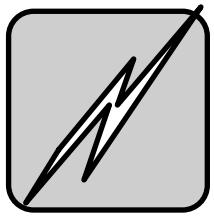
- Bulbs



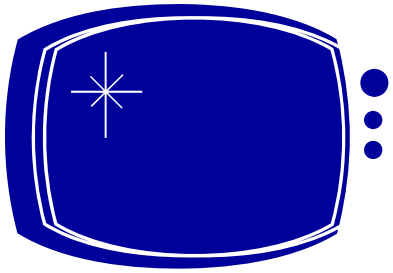
- Fuses



- Cords



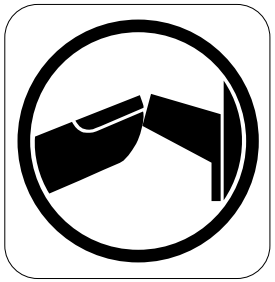
- Power Sources



- Optical surfaces

# BULBS

- Lifespan
  - Short: Projectors, Slitlamps, Microscopes.
  - Long: Lensometers.
- Prolonging Life of Bulbs
  - Turn on unit at lowest voltage setting; sudden high voltage surges can blow bulbs.
  - Use at lower settings as much as possible.
  - Turn off after using.



  - Don’t move a surgical microscope when the lamp is on. Even gentle vibration may cause the filament in the bulb to break.

# BULBS

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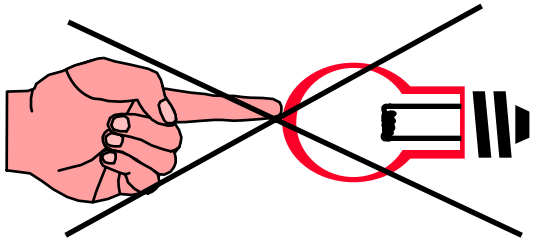
- Removing and Installing Bulbs
  - Shut off machine and unplug.
  - Let bulb cool off before removing.
  - Do not touch bulb directly with fingers; use tissue to prevent oil deposits as oil burns into glass causing shadow.



  - Observe correct alignment of filament to prevent uneven light being projected.
  - Know how each specific bulb fits into its socket.

# BULBS

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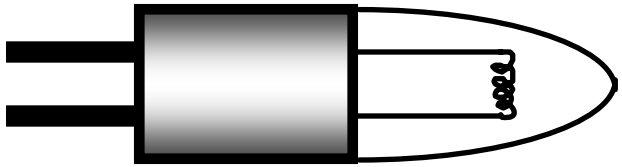
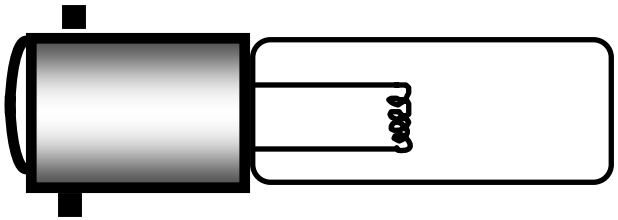
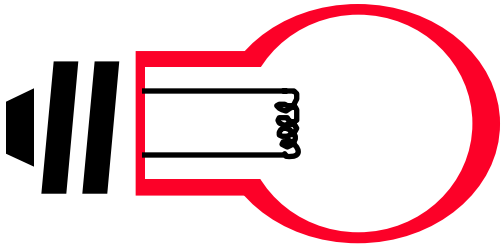


Straight push-in prongs



Bayonet Mounts



Screw-in

# BULBS

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- Inspecting Bulbs
  - Check contact points on housing and bulb; scrape off any corrosion.
  - If oxidation  is on one side only turn bulb 180°.
  - Check for bent filaments, specially for ophthalmoscopes and retinoscopes.
  - inspect filament for continuity and welding points- loose filaments produce a blue arc of light and flickering.

# BULBS

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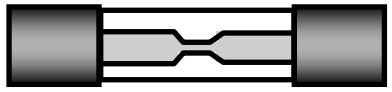
- Keep a Bulb Inventory
  - Store all bulbs by type in labeled bins.
  - Check inventory frequently.
  - Order extra bulbs when you buy the equipment.

**Instrument: Zeiss SL-30 Slit Lamp**
**Voltage: 6V Wattage: 25W**

**Distributor: Bulb City, 19 S. Bank St**
**Singapore Tel: 67453**

**Part Number: 166785-2**
**Price: $10.50**

**Minimum Stock Level: 2**
**Maximum Stock Level: 6**



# FUSES

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- Designed to prevent overloading of electrical currents in the machine.
- Use correct amperage value.
- Do not substitute fast-blow with slow blow fuses.
- Have extra fuses taped to the instrument.
- If a fuse repeatedly burns out then corrective maintenance is required.

# NEVER bypass a fuse!

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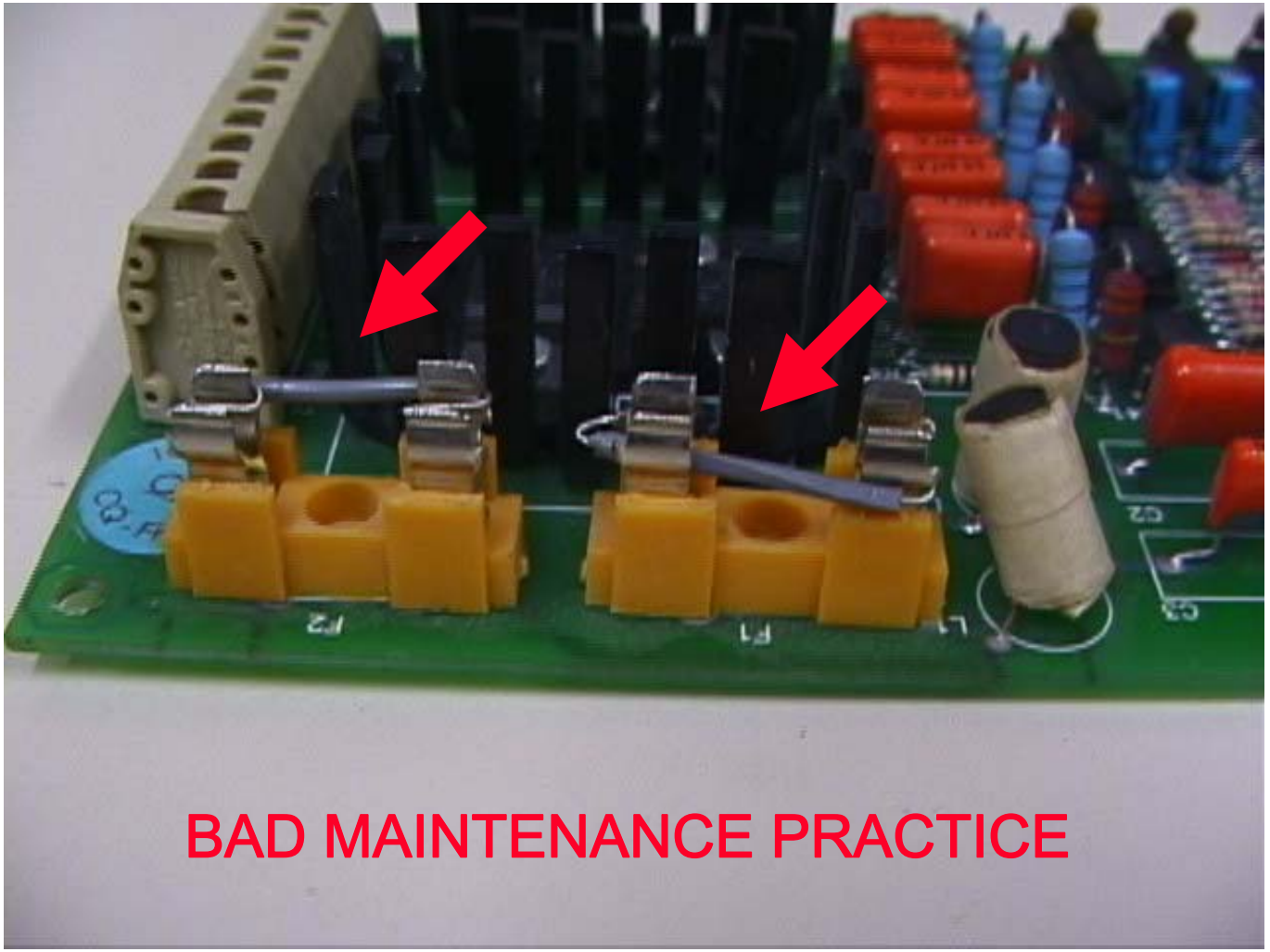

# NEVER bypass a fuse!

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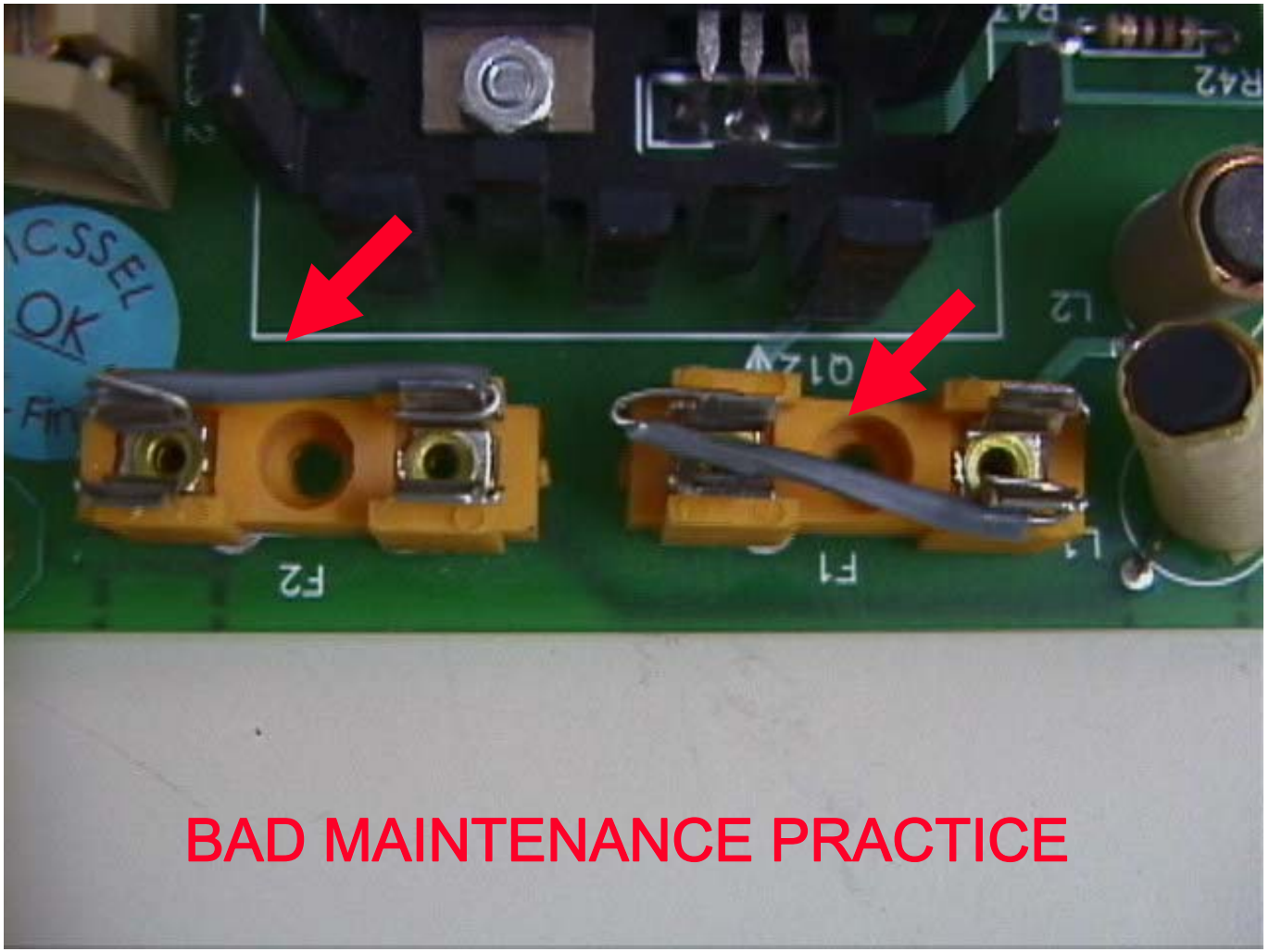

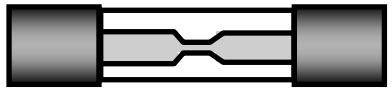

# FUSES

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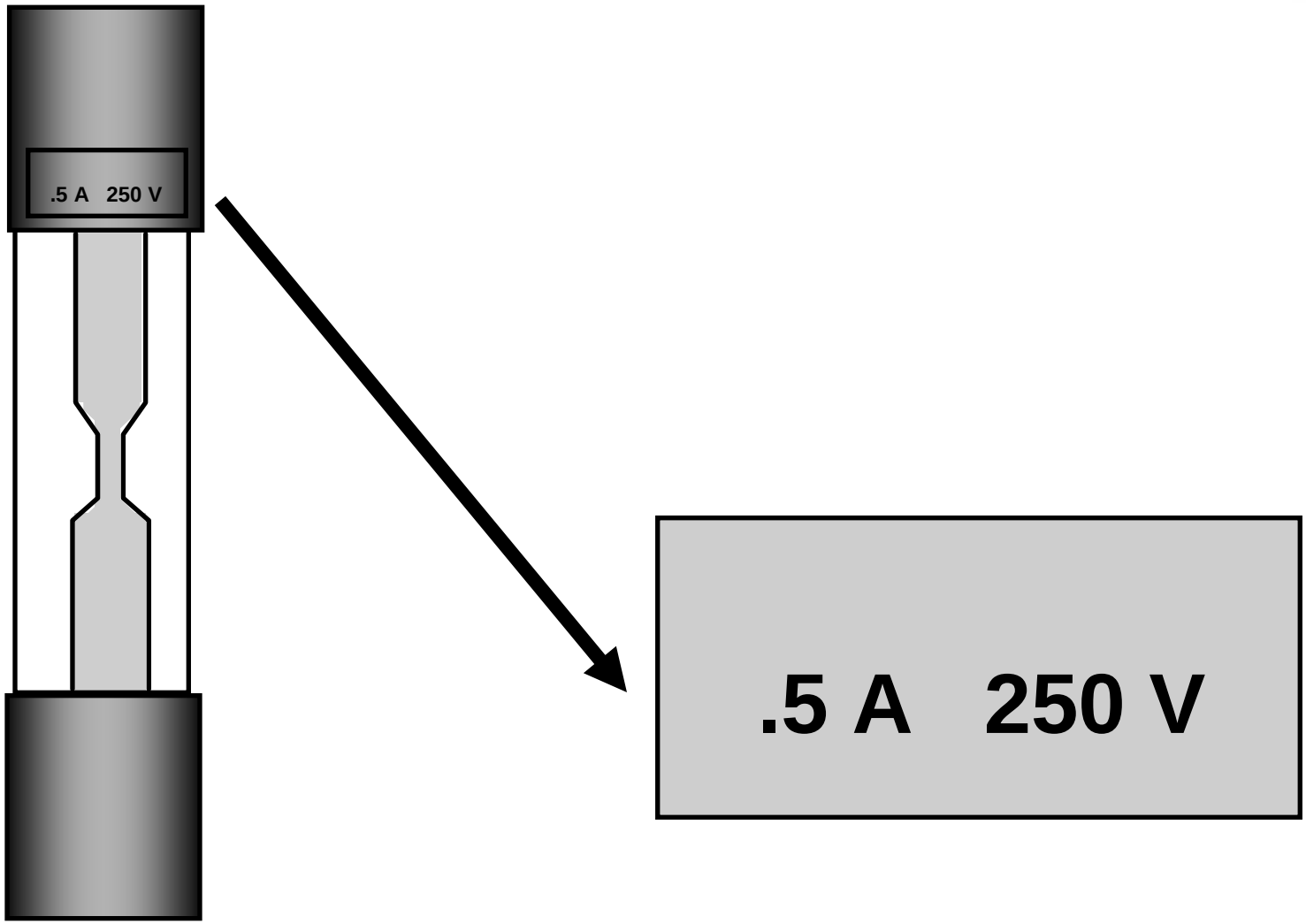
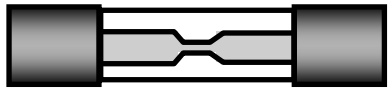




# FUSES

- Keep a Fuse Inventory
  - Store by type in labeled bins
  - Check Inventory Frequently

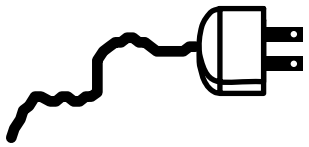
**Amperes: 2.5** **Voltage: 250 V**

**Type: Slow-Blow**

**Instruments: Zeiss SL-30, SL-50. Haag Streit DP 201, 203**

**Minimum Stock Level: 6**

**Maximum Stock Level: 10**



# CORDS

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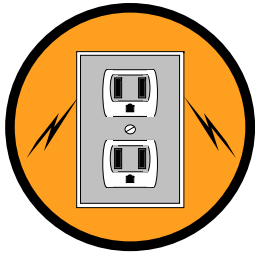
- File off corrosion from contacts.
- Wiggle cord to see if light flickers.
- Keep spare cords.
- When removing cords from their connections pull on the strain relief and not the wire.
- If a new cord does not work, the transformer or the power supply may be defective.

# POWER SOURCES



## Wall Sockets

- Make sure voltage selector switch is set for your wall voltage.
- If the equipment's input voltage is different then that of your hospital then use an appropriate transformer.
- Do not turn on computerized equipment on and off rapidly.
- Computerized equipment should be protected by a surge protector (for example: A/B scans).
- In case of severe power quality distortions, electronically sensitive (μ-processed) equipment should be connected to a good voltage stabilizer (e.g., a step) or an online UPS.

# POWER SOURCES

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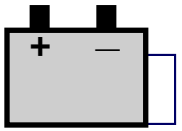
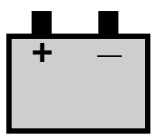



## Rechargeable Batteries

- Features:
  - Shelf life marked on battery.
  - life span of about 2-3 years.
  - most batteries can only be inserted in one direction (usually denoted by an arrow).
- Deplete complete battery charge before recharging (use instrument all day without recharging then recharge overnight).
- As the battery ages the instrument will not work all day without additional periods of recharging.

Frequency of Recharging Battery Operating Time

# POWER SOURCES




## Regular Batteries

- Store in refrigerator.
- Remove all batteries from unused equipment- battery might leak acid and corrode instrument.
- Do not attempt to recharge regular batteries.

# POWER SOURCES

## Keep a Battery Inventory

- Keep in labeled bins.
- Consider shelf life when determining stock levels.
- Check inventory frequently

**Voltage: 7.5 V Type: Rechargeable**

**Instruments: Heini Direct Ophthalmoscope**

**Distributor: International Battery Company, 22 S. Battery Lane, Bangkok , Thailand Tel:892334**

**Minimum Stock Level: 2**
**Maximum Stock Level: 4**

# Cleaning and lubrication of mechanical parts

- Cleaning – to remove grease:
  - WD40 or any equivalent micro oil; or
  - Engine oil SAE30 or equivalent.

- Lubrication:
  - White silicon grease.
  - For fine mechanical parts Singer oil can be utilized.

NOTE: Do not utilize Graffiti-based lubricants with ophthalmic equipment.

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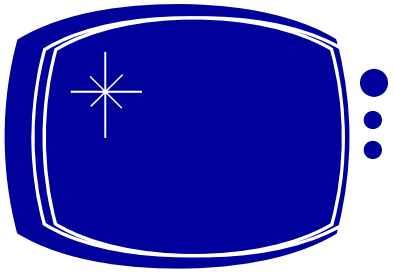
# OPTICAL SURFACES



# Optical surfaces

- Almost all ophthalmic equipment have optical components like glass plates, lenses, mirrors and prisms.
- Surfaces of optical elements like prisms, mirrors, bean splitters, windows and filters used in ophthalmic equipment are specially prepared:
  - They are highly polished; any irregularities on the surface will be less than a fraction of the wavelength.
  - Additionally, special coating of certain materials is also present on the surface of lenses to get some desired functions.
- The coating is a thin chemical film deposited onto the lens surface.

# Coatings

- Surfaces of lenses, prisms and windows are usually given an antireflection coating (ARC) to prevent loss of light due to reflection. This ensures maximum transmission of light through the surface.
- Mirrors have a highly reflecting coating to get maximum reflection of light.
- Bean splitters have a coating of special thickness to have a certain percentage of reflected light and the balance is transmitted through them.
- Filters have coatings to cut out undesired wavelengths.
- In the case of lasers, the mirrors used have coatings to give a reflectivity as high as 99.95% or better for a given wavelength.

# Coatings, other types

- Visible Broadband AntiReflection
- Near-Infrared Broadband AntiReflection
- Extended Broadband AntiReflection
- V and 2V Narrowband AntiReflection
- Single Layer MgF2
- Broadband High Reflectance
- Narrowband High Reflectance (Notch Filter)
- Dielectric High Reflectance
- Aluminum Coatings
- Silver and Gold
- Dielectric Laser Mirror
- Dual Laser Line Mirror
- Hot and Cold Mirrors
- Broadband Visible Beamsplitter
- NIR & Telecom Non-Polarizing Beamsplitter
- Non-Polarizing Coatings
- Brewster Plate Polarizing
- Broadband and Laser Line Cube Polarizers
- High Efficiency Telecom Polarizing Filters
- Long Wave and Short Wave Pass
- Bandpass

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## Optical surfaces

- Scratches on an optical surface produce unwanted scattering of light. Dust particles may produce scratches if they are not properly removed.
- If wiped with a cloth, dust particles may scratch the surface of optical components, thereby reducing the quality of the optical element.
- Therefore, optical surfaces should never be wiped to removed dust especially when they are dry. Dust must be blown off.
- Sharp instruments, even sharp fingernails, may cause a scratch. One should be careful in using sharp instruments near optical surfaces when removing or refitting the optical elements.

## Optical surfaces

- Holding the elements by their edge is important.
- Don’t touch optical surfaces with bare fingers.
- Optical surfaces that require cleaning may be cleaned following the procedures described next. However, repeated cleaning may wear out some of the coating described earlier and the property of the surface may change.
- “Prevention is better than cure” is an important rule with such surfaces. Keep them protected from dust, stain and fungus is always better than trying to remove them frequently.
- Hence great care should be exercised in removing dust and stain on optical components.

# CLEANING

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- Cleaning external surfaces
- Cleaning contaminated instruments
- Material for lens cleaning
- Cleaning lenses
- Preventing / removing fungus

# CLEANING

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- External surfaces
  - Read Manufacturer's instructions.
  - Some surfaces may be damaged by harsh cleaners and alcohol.
  - Do not spray cleaner on the surface. Spray cleaner on wipe / gauze / towel first. This prevents solution from running into machine.
  - Keep instruments covered when not in use.

# CLEANING

- Gauze

# CLEANING

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- Cleaning Contaminated Instruments
  - Common sources of contamination include Hepatitis, Herpes Simplex, Chlamydia, TB, AIDS or contagious bacteria and viruses.
  - For external surfaces that do not touch the eye use alcohol swabs if appropriate. If alcohol causes any damage then use manufacturer's recommended solution.
  - For concern of AIDS transmission wipe down with a 1:9 dilution of bleach (NaOCl).
  - For instruments that come in contact with the eye (applanation tonometers, goniolens) soak for 10 minutes with 3% hydrogen peroxide. Change solution twice a day. Alcohol can also be used. Do not use bleach.

# Material for lens cleaning

- air blowers;
- lens brush;
- cotton swab;
- lens tissue;
- lens cleaning solution;
- lens fungicide.

# Air blowers / lens brusher

(blower bulb, duster,
pressurized air can)

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# Cotton swabs

# Cotton swabs

- Non-sterile, medical grade

# Cotton swabs

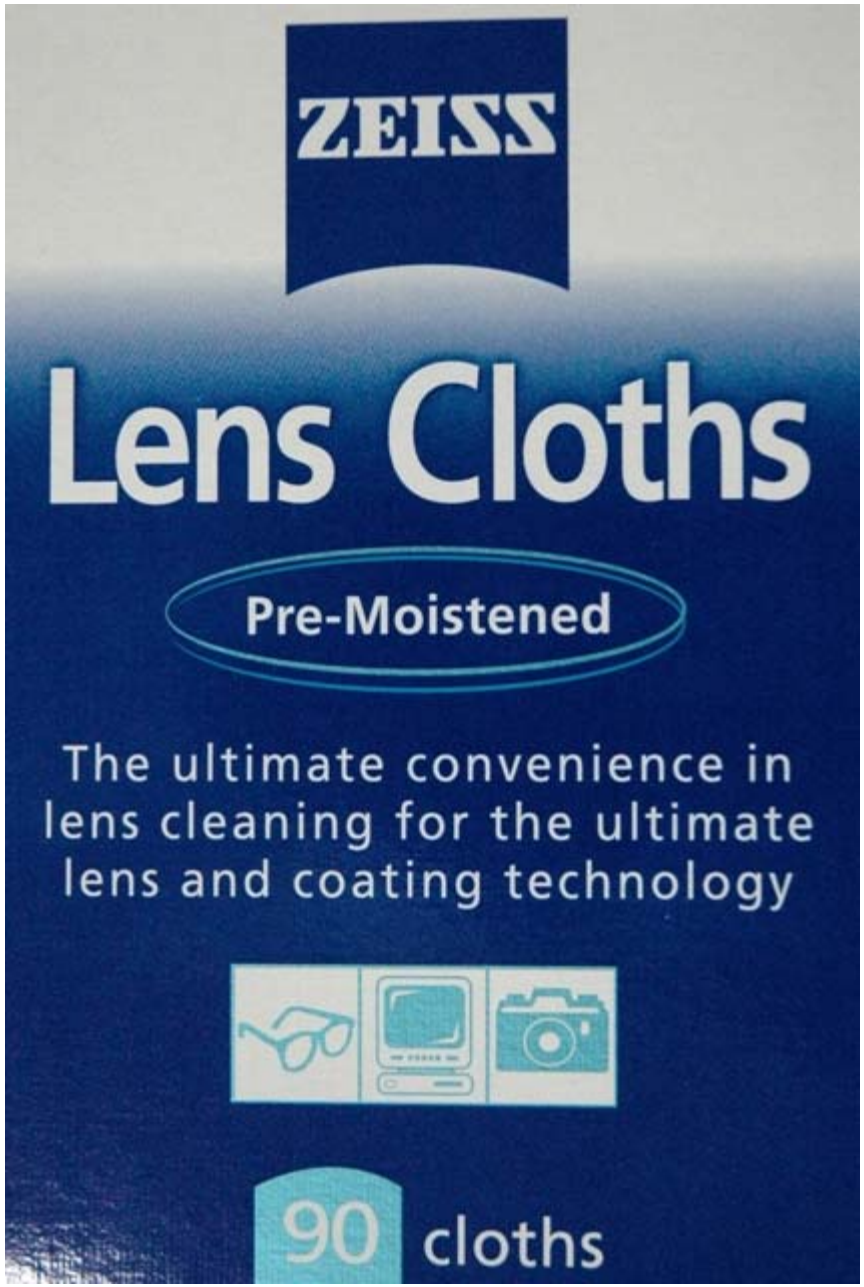
- Use medical grade cotton swabs, non-sterile, which fibers have been degreased / defatted, and don't release lint.

- Alternatively, if non-sterile, medical-grade cotton swabs are not commercially available, fresh cotton swabs can be prepared with wooden sticks and medical-grade cotton.

# Lens tissue

- Find in the specifications the information that the tissue will not damage lens coating.

# Lens tissue – Pre-moistened




Lens tissue +
isopropyl alcohol

# Lens cleaning solution, water-based, e.g., Kodak, Zeiss

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# Lens cleaning solution

- Alternatively, if lens cleaning solution is not commercially available, a water-based mild detergent solution can be utilized.

# “Home-made” lens cleaning solution

Water-based solution:

- 1 part of a mild neutral detergent
- 19 parts of distilled water

“Stronger” solution:

- 3 parts of ether
- 7 parts of isopropyl alcohol

# Lens fungicide, e.g., Zeiss

# Lens fungicide

- Alternatively, if lens fungicide is not commercially available, scrub soap (e.g., Hibis scrub *) can yield good results.

(*) It is germicide/antimicrobial and not aggressive to the skin).

# CLEANING

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- Cleaning lenses – Outline:
  - wipe down device (and table it is on);
  - be careful not to touch optics;
  - cover optics when not in use;
  - first clean around the lens (with cotton swab);
  - then clean lens itself.

# Cleaning lenses - RECIPE

- never touch lens with fingers (oil, scratch);
- blow / brush off large pieces of dirt first;
- apply the lens cleaning solution first to the cotton swab or the lens tissue; don't apply the solution directly to the lens surface;
- then use a cotton swab or lens tissue to gently wipe lens, using the appropriate cleaning solution;
- wipe in a spiral motion, starting at the center and spiraling out (this way you do not wipe dirt into the area already cleaned); the swab is to be moved in a circular way, starting from the center and following a spiral pathway towards the edge;
- this is to be repeated using a new cotton swab / lens tissue sheet every time until the stain is no longer visible at any angle of observation under direct light;
- for rectangular / square optical elements, the swab is to be moved always in one direction only;
- any cotton lint left on the component is to be removed by blowing or using a clean brusher.

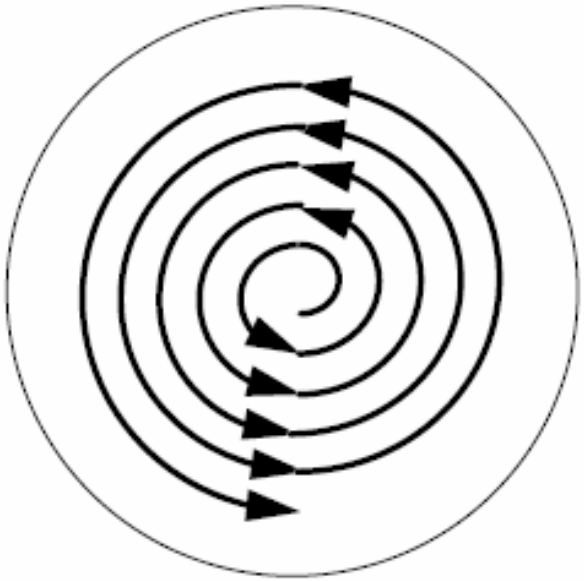

*Fig. Shows the spiral path of the cleaning swab while cleaning circular optical elements*

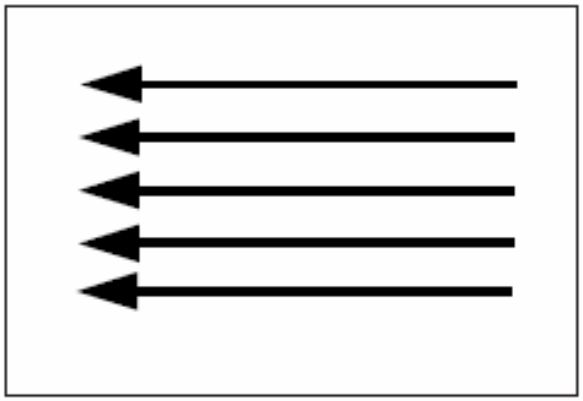

*Fig. Shows the lateral path of the cleaning swab while cleaning rectangular or square optical elements*

# Cleaning lenses – What solution should I use?

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**<u>Get manufacturer's recommendations of cleaning procedures (i.e., which cleaning solutions to use)</u>**.

**<u>If no information is available</u>**:

- try water-based solutions first (mild soap and distilled water), e.g., Kodak lens cleaner);
- then high-purity alcohol (alcohol 100%, methanol or ethanol);
- then high-purity acetone, benzene, ether, or any other organic solvent * (but not on mounted lenses);
- plastic lenses:
  - no organic solvents * (will destroy the lens);
  - alcohol is probably Ok;
- mirrors:
  - usually on the front of lens;
  - easily scratched (avoid cleaning);
  - use methanol or acetone (will dry off without residue);
- laser optics: very special handling, for specialists only.

# CLEANING

- Preventing fungus
- Removing fungus

# Fungus among us…

- Fungus is very bad news.
- Fungus can grow on the lens element surfaces. Fungus grows in a very distinctive and delicate tracery pattern on the lens.
- Early on, the fungus can be removed before it does major damage by disassembly and cleaning.
- Fungi secrete enzymes and acids to chemically alter their environment so they can absorb nutrients. After a while, the fungus actually etches a pattern into the lens surface. It is like a fingerprint, only potentially even worse in its adverse effects on contrast.
- Usually, the cost to fix the lens once it has become etched by fungus is so high as to be uneconomic.
- Fungus can be removed by applying fungicide. Direct exposure to ultraviolet light is reported to kill fungus too.

# Fungus among us…

- In its first stages, fungus will not be perceivable by the clinician.
- With time the fungus covers the lens surface in a web like manner.
- Initially there will be a very slight loss of image brightness, followed by decreased contrast due to light reflecting off the fungus.
- In its final stages, the lens outer coatings are etched by the fungus and image sharpness deteriorates.
- You will probably be able to use the lens for many months, depending on how humid the environment is, before it reaches this stage.

# Fungus growth

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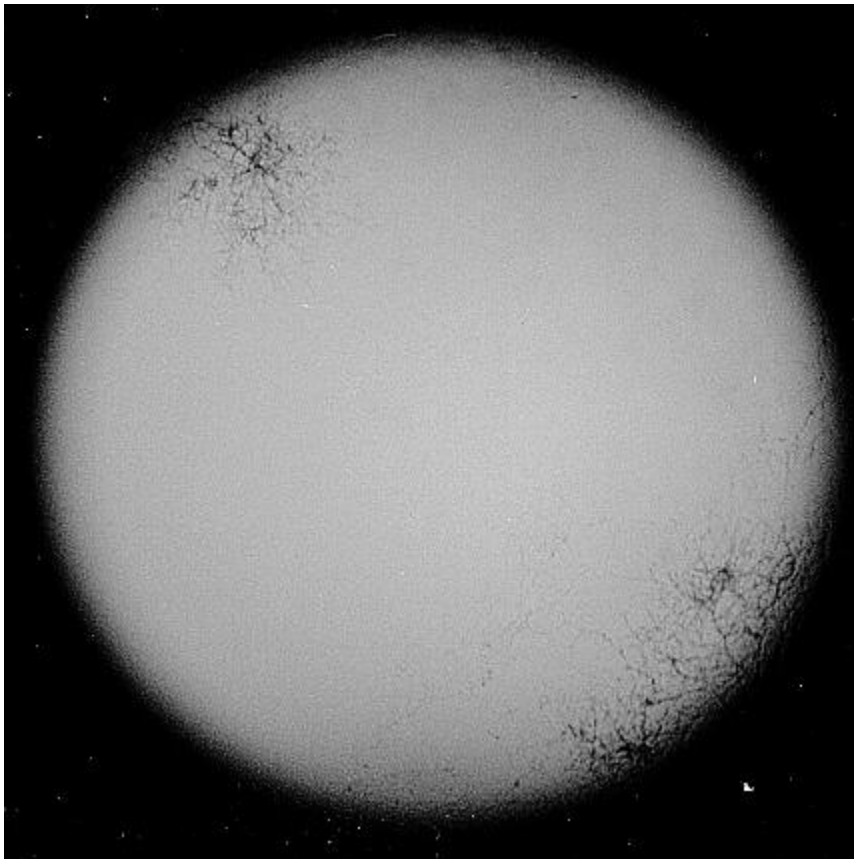

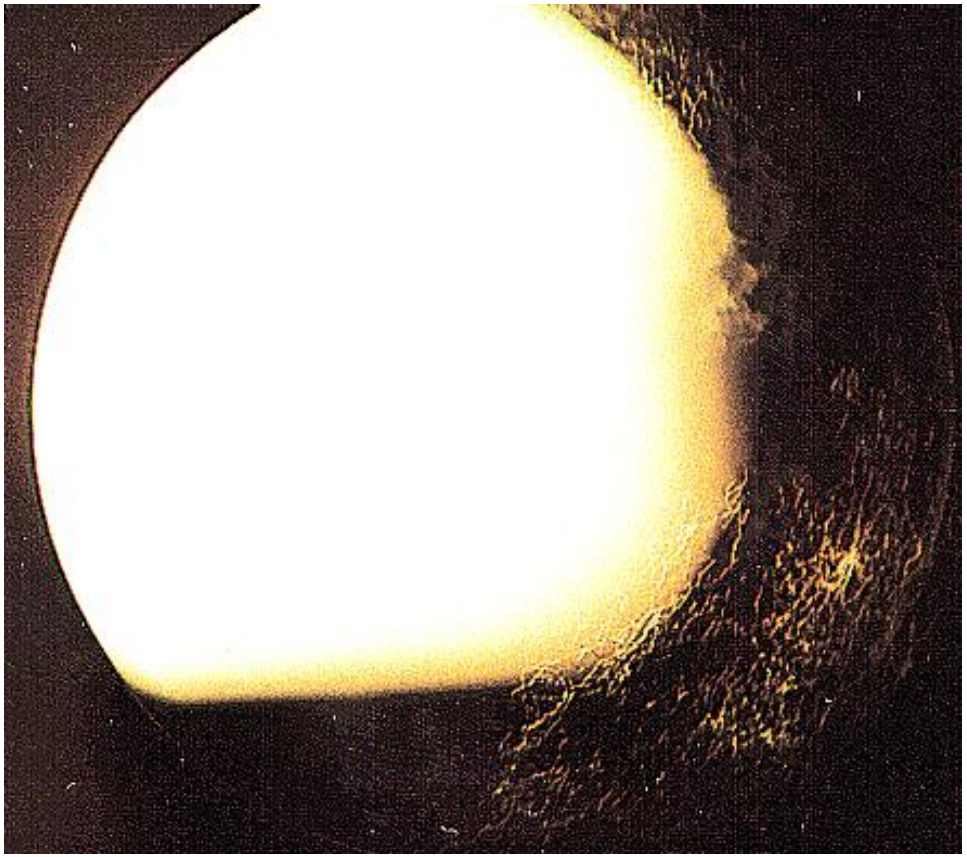

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http://www.chem.helsinki.fi/~toomas/photo/life-in-camera.html

# Fungus growth

Fundus camera TRC 50EX Topcon
Photo: Courtesy of Patrick J. Saine, Oct 2006
http://www.pjsaine.com

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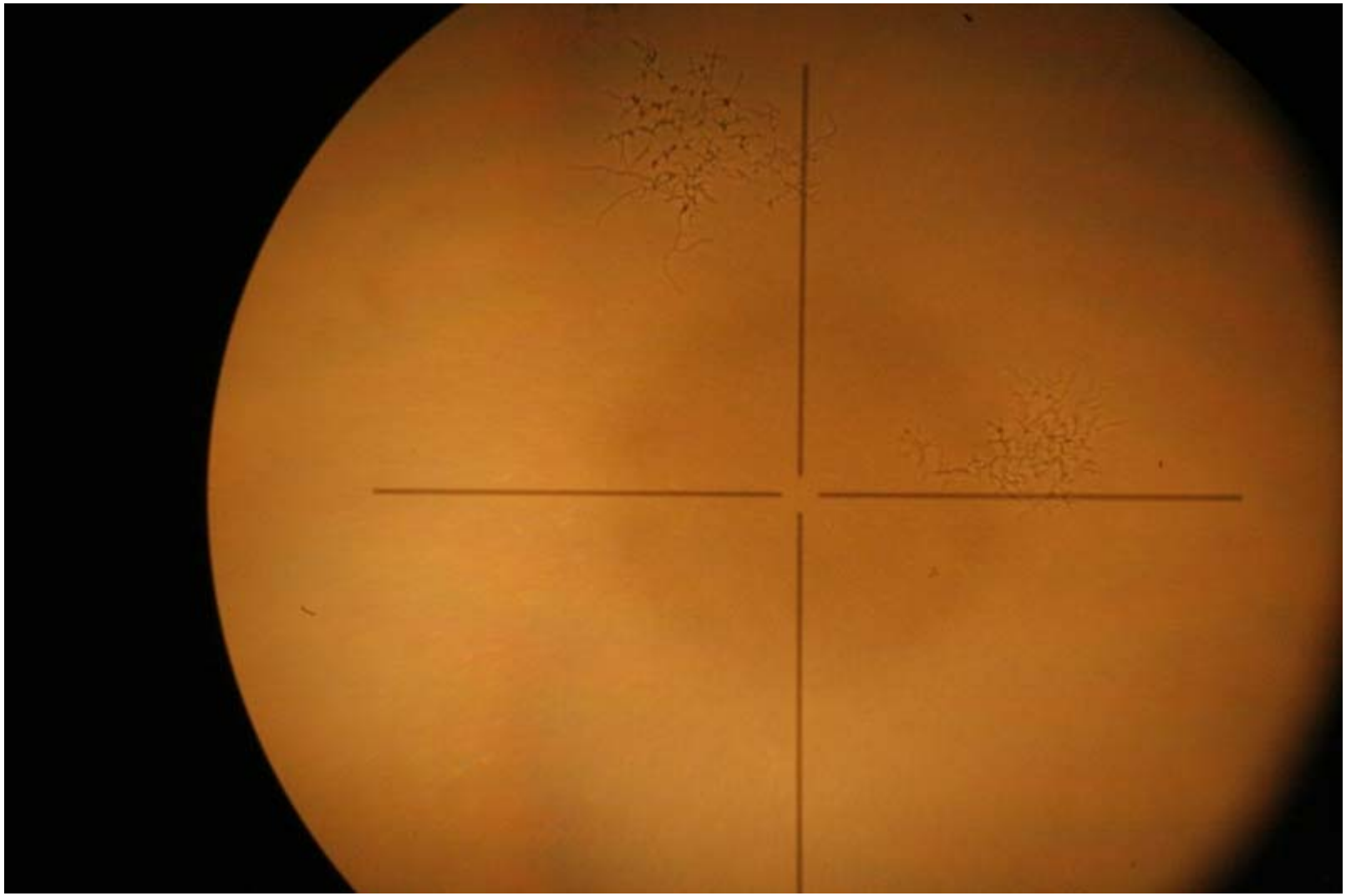

# Fungus growth

Fundus camera TRC 50EX Topcon
Photo: Courtesy of Patrick J. Saine, Oct 2006
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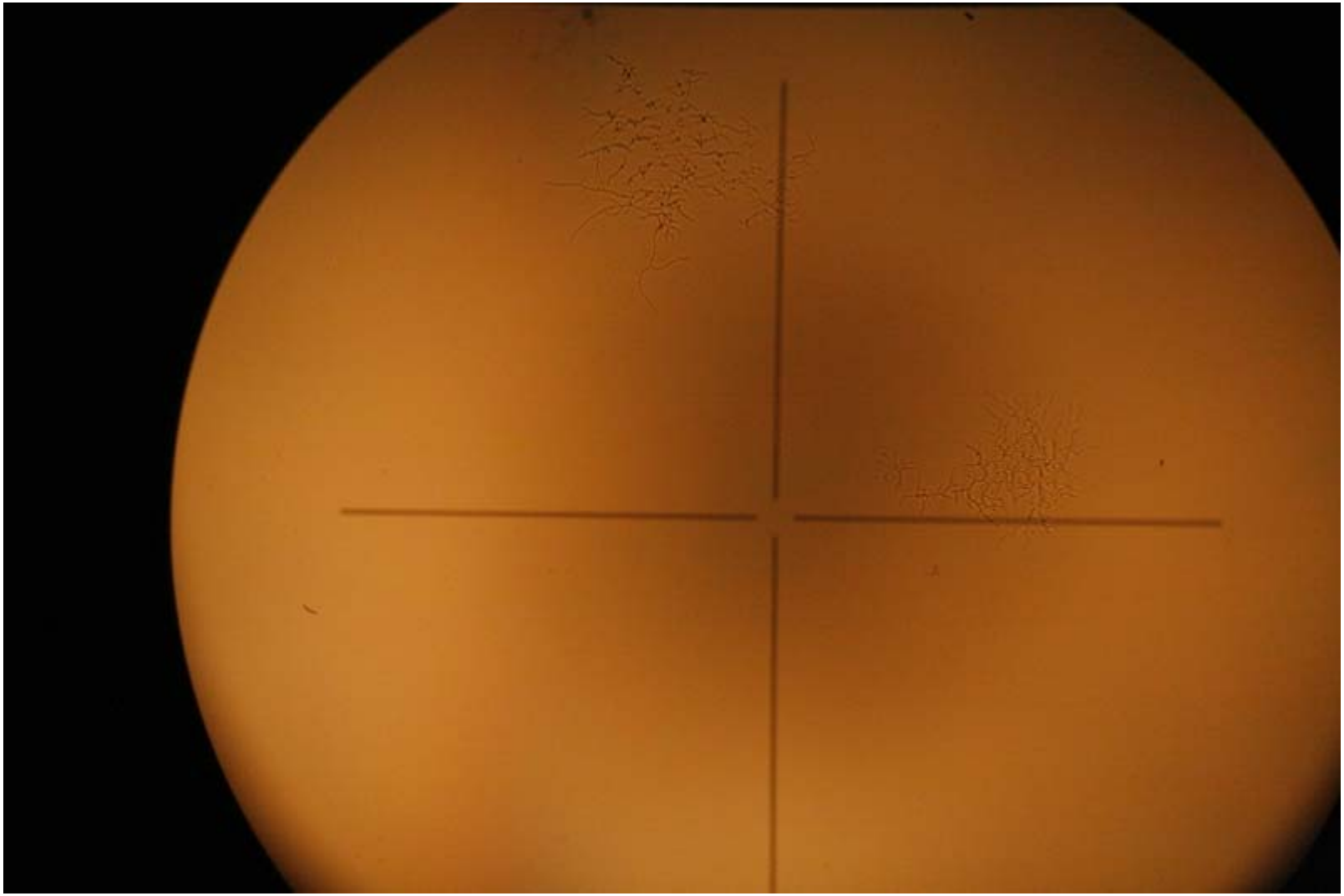

# Fungus growth

Fundus camera TRC 50EX Topcon – Adapter piece to Nikon D100 digital camera

October 2006

# Fungus growth

Fundus camera TRC 50EX
Topcon – Eyepiece
October 2006

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# Fungus growth

Fundus camera TRC 50EX Topcon – Eyepiece
October 2006

# Fungus prevention

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- There is no recipe which would give you 100% guarantee that you will never get fungus in your lens. The following suggestions may reduce your risk, however.

- Keep the optics in a dry place with plenty of air circulation. If relative air humidity is high air conditioners and dehumidifiers are strongly recommended).

- Do not cover optics with plastic drape covers (commonly supplied by medical equipment manufacturers) since these will retain humidity. If you need to drape the equipment to protect against dust, use a porous cloth cover.

- If you need to keep certain optics in sealed containers, place silica gel packs with it to absorb any humidity. It is important, though, to check the silica for discoloration or moisture to know when to replace it (or dry it off again).

# Dehumidifiers

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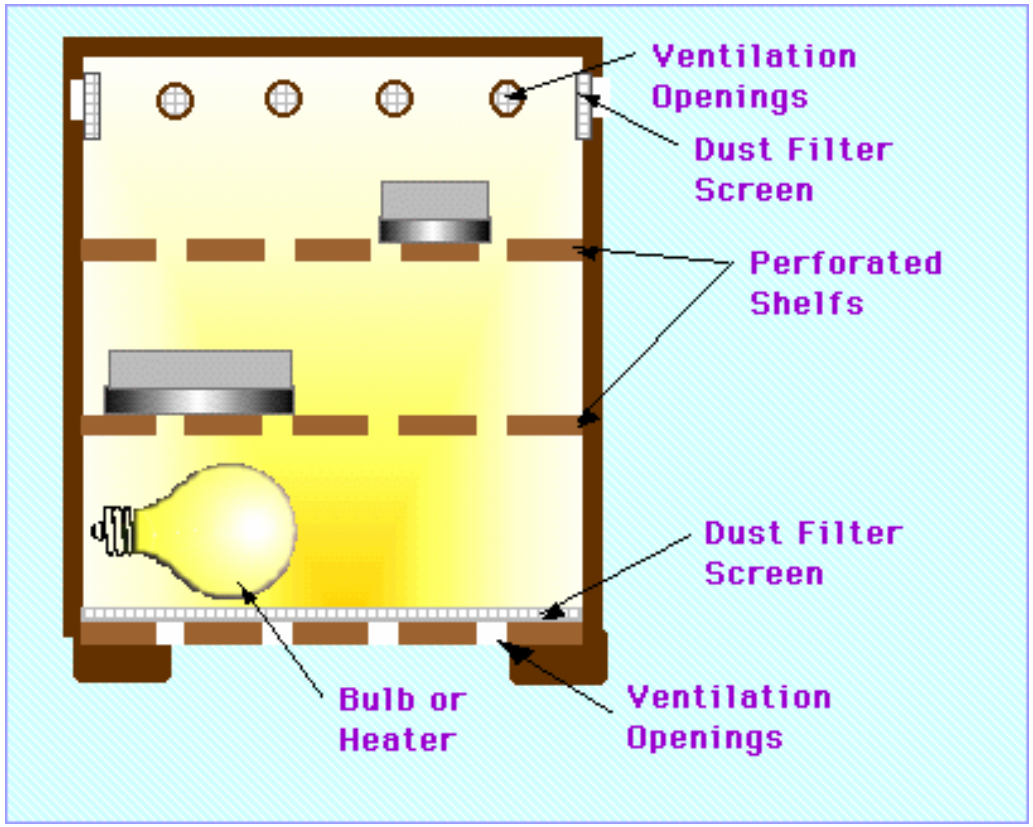
# Air conditioners and dehumidifiers represent $$$

"You can pay it now or you can pay it later…"

Leo de Kryger, ORBIS FEH volunteer faculty.

# Tip

- If it is difficult to keep the environment dry, an effective and low-cost solution is to construct a drying box to store the optical components of equipment when not in use.



# Fungus Removal

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- Removing fungus from lenses is extremely difficult and rarely yields good results.
- You can use ultraviolet radiation (sunlight or an ultraviolet lamp) or paraldehyde to kill it.
- Once killed, the fungus may be easier to remove but the outer coatings of the lens will most likely have irreversible damage.

# CLEANING

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- Removing fungus
  - Blow dust off of lens.
  - Use fungicide made for optics (e.g., Zeiss) or an alternative product such as scrub soap.
  - Soak cotton swab or lens tissue with fungicide and apply to lens.
  - Leave on lens for one hour or more (???) Fungicide will dissolve (kill) fungus and then wipe it off with cotton swab or lens tissue.
  - Clean lens with lens cleaning solution.

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